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PLASMA RESISTANT MEMBER AND MANUFACTURING METHOD THEREFOR

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[There are no amendments to this patent.]

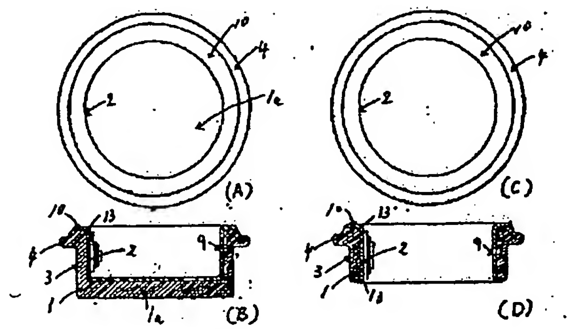
Abstract

Problems

To provide a plasma resistant member on which is formed a film with excellent plasma resistance, and a manufacturing method therefor.

Means to solve

It is composed of tubular body (1) with one end sealed or both ends open. Plasma resistant film (9) is furnished on inner circumferential surface (2) and on sealing surface (10) at the end of said tubular body (1), and projecting part (4) is also formed on outer circumferential surface (3).



Claims

1. Plasma resistant member characterized in that it is composed of a tubular body with one end sealed or both ends open, a plasma resistant film is furnished on the inner circumferential surface and on the sealing surface at the end of said tubular body, and a projecting part is also formed on the outer circumferential surface.

2. Plasma resistant member described in Claim 1 characterized in that the aforementioned projecting part is formed at a different height than the sealing surface of the tubular body.

3. Plasma resistant member described in Claim 1 characterized in that the aforementioned projecting part is formed on the same surface as the sealing surface of the tubular body, and a plasma resistant film is also furnished for this projecting part.

4. Plasma resistant member described in Claims 1-3 characterized in that the aforementioned plasma resistant film is formed with one or more of the following: silicon carbide, boron carbide, silicon oxide, aluminum nitride, YAG, or $MgAl_2O_4$.

5. Plasma resistant member manufacturing method characterized in that a projecting part is formed on the outer circumferential surface of a tubular body with one end sealed or both ends open, and with this projecting part being mounted on the top surface of a tubular support member, a plasma resistant film is formed on the inner circumferential surface and on the sealing surface at the end of the aforementioned tubular body.

6. Plasma resistant member manufacturing method described in Claim 5 characterized in that a support member and another tubular body are further stacked on the aforementioned projecting part, and a plasma resistant film is formed simultaneously on multiple tubular bodies.

Detailed explanation of the invention

[0001]

Technical field to which the invention belongs

This invention pertains to: the domes, chambers, or rings that are the inner wall members of dry etching devices that use fluorine, chlorine, bromine, oxygen, or hydrogen gas, and of dry etching devices that use high-density plasma produced by a magnetic field or high-frequency induction, to the chambers that are the reaction vessels of ECR (Electron Cyclotron Resonance) – CVD devices; and further, to the inner wall members of light emitting tubes of ArF or KrF excimer lasers, and to the members used as jigs, e.g., support bodies that support the processed objects, which must be plasma resistant and semiconducting for semiconductor manufacturing devices and liquid crystal manufacturing devices.

[0002]

High integration technology for semiconductor memory DRAMs has improved productivity by miniaturizing design rules 0.6-0.7 times per generation, and by enlarging the wafer area 1.3 times per generation, where 3 years are one generation.

[0003]

It is necessary to shorten the wavelength used with the exposure device, and etching with a high aspect ratio is also required to miniaturize the line width of a semiconductor memory. High-density plasma is used for performing this etching with a high aspect ratio. Members exposed to the plasma must be plasma resistant and highly pure in order to prevent the generation of particles or impurities by physical and chemical etching in a high-density plasma.

[0004]

In the past, high purity SiO_2 quartz glass material or polysilicon would have been used for the inner wall members of chambers or domes that are the plasma irradiated parts of the dry etching device or ECR plasma CVD device of a semiconductor manufacturing apparatus, and high purity SiO_2 quartz glass material would have been used for the inner wall members that are the plasma irradiated parts of an excimer laser light emitting tube.

[0005]

Also, sintered alumina materials, alumina and titanium carbide composite ceramics, and sapphire, sintered aluminum carbide materials, or items with a film of these formed on the surface by some method such as CVD; in concrete terms, items where sintered silicon carbide materials are coated with a silicon carbide film by CVD or items where inexpensive sintered

ceramic materials are coated with DLC (diamond-like carbon), have been used as the handling jigs or susceptors that support and secure wafers and as materials for heaters in semiconductor manufacturing devices.

[0006]

With plasma processes in semiconductor memory manufacturing, fluorine, chlorine, bromine, oxygen, or hydrogen gas is used. These gases are used alone or mixed, and they are used for etching semiconductor elements or cleaning the devices.

[0007]

Members that come into contact with these corrosive gases must be highly plasma-resistant, low-particle [transliteration] and highly pure. With high-density dry etching devices that use high-frequency induction, methods for changing the conductivity between the inner wall material and outer wall material to control transmission or absorption of high frequencies by the inner wall material have been proposed, and a variety of materials that provide both of these [functions] have been investigated.

[0008]

In concrete terms, in etching of silicon oxide films, the starting material has been made highly pure for the purpose of making the [final] material more pure and for improving plasma resistance, and SiO_2 quartz glass and crystalline quartz having a purity of 99.99% with regard to lower OH groups have been used.

[0009]

However, with the glass and highly pure SiO_2 quartz glass material used in the past, plasma resistance is insufficient, and there is considerable consumption. In particular, when it contacts fluorine or chlorine plasma, the contact surface is etched, producing the problem that the etching conditions change due to changes in the surface properties or the dissociation of oxygen.

[0010]

Therefore, because ceramics, e.g., alumina, aluminum nitride, silicon carbide, silicon nitride, $MgAl_2O_4$, and YAG, have superior plasma resistance, in comparison to conventional quartz glass, they have come to be used with semiconductor manufacturing devices for a variety of processes. Methods for utilizing the features of these ceramic materials to achieve outstanding plasma resistance and higher purity have been investigated. As one of those methods, a method where silicon carbide is sintered in a fine carbon vessel has been introduced in Japanese Kokai

Patent Application No. Hei 1[1989]-252580. Methods of forming high purity films on the surface of a substrate of the same material, or a material with relatively similar thermal expansion, using CVD, PVD, or the like have also been proposed to provide a higher level of purity. Of these, the details of applying silicon carbide CVD to highly pure silicon carbide for the purpose of providing higher purity is disclosed in Japanese Kokoku Patent No. Hei 7[1995]-88256.

[0011]

It has also been proposed in Japanese Kokai Patent Application No. Hei 9[1997]-295863 to use ceramic materials with group IIIa elements from the Periodic Table, which have excellent plasma resistance to fluorine and chlorine plasma, as their principal materials. It has been proposed in Japanese Kokai Patent Application No. Hei 10[1998]-45467 to use ceramic materials with composite oxides of group IIIa elements from the Periodic Table and Al or Si as their principal materials, and it has been proposed in Japanese Patent Application No. Hei 9[1997]-328449 to provide higher purity by making the impurities in these materials less than 0.1 wt%. Using composite oxides of group IIa and IIIa [elements] from the Periodic Table has also been proposed in Japanese Kokai Patent Application No. Hei 10[1998]-45461. An example that uses composite oxides of groups IIa, IIIa, and IIIb has also been proposed in Japanese Kokai Patent Application No. Hei 10[1998]-67554. In more concrete terms, a member that uses YAG, which has excellent plasma resistance, has been proposed in Japanese Patent Application No. Hei 9[1997]-42604. Currently, there has further been progress in the application of silicon nitride, silicon carbide, and boron carbide, which have high covalent bonding characteristics and are chemically stable.

[0012]

Incidentally, each of these materials, e.g., alumina, $MgAl_2O_4$, or YAG oxide ceramics, carbide ceramics, e.g., silicon carbide or boron carbide, and nitride ceramics, e.g., silicon nitride or aluminum nitride, while superior in plasma resistance compared to conventional quartz glass, are inferior to high purity quartz glass form the standpoint of purity. When they contact plasma at high temperatures, corrosion progresses gradually, and grain boundaries that remain, or dropping out of crystal particles that may occur because of selective etching occurring at the surface of the sintered material, and problems that are a factor in particle generation become a concern.

[0013]

Particles are generated by physical action, e.g., ion impact, or they are generated by repeated dissociation or reassociation of reaction products produced by the chemical vapor phase reaction. Breakage or short-circuiting of the metal wiring, or pattern defects are produced, and may cause only degradation of the semiconductor element or a drop in yield, or they may become a major obstacle to a higher degree of integration of semiconductor memories. Particularly with dry etching processes, particle generation is the largest cause of problems, and once particles are generated, it is necessary to release the vacuum and sweep out and clean the inside of the chamber or dome, which would cause a large loss of man-hours.

[0014]

Thus, even with plasma resistant materials such as those mentioned above, higher integration with a memory line width of less than 0.25 μm has not been possible, satisfactory plasma resistance has not been achieved, and the problem of particles still remains. Methods where a film with excellent plasma resistance, low defects, and uniformly high purity is formed on the surface on which the corrosive gas plasma acts, and methods for forming silicon carbide CVD films on highly pure silicon carbide have been proposed as solutions to these problems.

[0015]

On the other hand, in high-frequency induction high-density plasma, there has been a demand for domes, chambers, and rings with a multilayer structure that will enable changing the conductivity of the inner wall member of the dome, chamber, or ring in order to allow introducing high-frequency waves of different frequencies, transmitting one high frequency, and blocking another high frequency.

[0016]

Problems to be solved by the invention

Materials where a plasma resistant film is formed on the inner circumferential surface and the end surface of a tubular body have been discovered as these members.

[0017]

However, when a plasma resistant film is formed on the inner circumferential surface and end surface of these members, the problems are that the film cannot be formed uniformly, and the film separates at the boundary between the inner circumferential surface and the end surface. It has also been difficult to form the film efficiently.

[0018]

In consideration of the aforementioned circumstances, the present inventor discovered a manufacturing method with which, when multiple layers of conductive materials that are plasma resistant and have different resistance values are required, it is possible for the film on the portion of the finished product exposed to the plasma and on the plasma sealing surface portion to be formed uniformly to produce a plasma resistant member, with a multilayer structure where the main surface that is exposed to the plasma and the plasma sealing surface are formed with a film that has the aforementioned characteristics, in the basic shape of a tubular drum with [one] end sealed or a round ring with both ends open, and with which it is possible to form finished product shapes that exhibit characteristics such that separation is unlikely to occur at the peripheral edge of the finished product, and it is possible to form stable films for multiple finished products.

[0019]

Furthermore, in addition to the plasma exposure surface, the plasma sealing surface must be of high purity to prevent inclusion of impurities in the plasma environment and to maintain a highly clean state. It is possible to achieve a highly clean plasma environment and to prevent inclusion of impurities by establishing an appropriate relationship between the pressure application point of the seal and the position having a film which is highly pure and has excellent plasma resistance that is formed on the plasma sealing surface.

[0020]

This invention was completed based on the aforementioned knowledge. Its purpose is to provide a plasma resistant member with a multilayer structure having long-term reliability on which is formed a film that has high purity and excellent plasma resistance where no particles will be generated from the surface that is exposed to plasma or from the plasma sealing surface, and to provide a plasma resistant member that has a multilayer structure of conductive materials having in part different resistances.

[0021]

Means for solving the problems

The plasma resistant member with multilayer structure of this invention has a structure composed of a tubular body with one end sealed or both ends open. A plasma resistant film is formed on the inner circumferential surface and on the sealing surface at the end of the tubular body, and a projecting part is also formed on the outer circumference. This projecting part may

be formed at a different height from the sealing surface of the tubular body, or may be formed anywhere on the same surface.

[0022]

Embodiments of the invention

Embodiments of this invention are explained below, with reference to the figures.

[0023]

Figures 1(A) and (B) show a plan view and cross section of a cylindrical drum shape with one end sealed, and Figures 1(C) and (D) show a plan view and cross section of a round ring shape with both ends open. Tubular body (1) (in Figure 1(B), integral with single-end sealing part (1a)) has inner circumferential surface (2), outer circumferential surface (3), projecting part (4), and end surface (sealing surface) (10). Plasma resistant film (9) is furnished on inner circumferential surface (2) and sealing surface (10). For both [cylindrical and ring shape], inner circumferential surface (2) is the area exposed to plasma, and there is a projecting part (4), on the outer circumferential surface (3) that is farther outside the circumference of the plasma environment than is sealing surface (10), and that has a different height than the plasma sealing surface and is not exposed to the plasma. This projecting part (4), as is discussed in detail below, is used for support during film formation, and an elastic member for sealing can be inserted when it is attached to the device.

[0024]

This tubular body (1) is made by sintering silicon carbide, boron carbide, silicon nitride, aluminum nitride, YAG, $MgAl_2O_4$, etc., and plasma resistant film (9), of silicon carbide, boron carbide, silicon nitride, aluminum nitride, YAG, $MgAl_2O_4$, etc., is formed on the surface of the substrate by CVD.

[0025]

The method for placing the substrate on the CVD device is shown in Figures 2(A) and (B). Cylindrical support member (5) is placed on finished product support stage (7) of the CVD device and projecting part (4) of tubular body (1) is supported by contact with support member (5). A second support member (5) is placed on projecting part (4) of tubular body (1) and a second tubular body (1) is placed on that. Support of projecting part (4) of tubular body (1) by support member (5) is repeated, multiple substrates are stacked up, and they are placed in the CVD device reaction vessel.

[0026]

Multiple tubular bodies (1) can be stacked vertically for efficient film formation by furnishing projecting part (4) on tubular body (1) and supporting it with support member (5), and films can be formed uniformly on both inner circumferential surface (2) and sealing surface (10). It is also preferable that actual support part (6) of support member (5) touch projecting part (4) discontinuously at the tip or touch discontinuously at a point, rather than touching the entire surface.

[0027]

Projecting parts (4) in Figures 1 and 2 are constructed with a shape whereby a step is formed on the outer circumference of sealing surface (10). The reason that a step is formed is so that sealing surface (10) can be formed with highly pure CVD film. In Figures 1 and 2, a step is formed at sealing surface (10) and projecting part (4), but the purpose can also be achieved with a shape where the flat part is left for sealing seal surface (10) and [elsewhere] it inclines continuously, as shown in Figure 3.

[0028]

Like Figure 1, Figures 3(A) and (B) show a plan view and cross section of a cylindrical drum shape with one end sealed, and Figures 3(C) and (D) show a plan view and cross section of a round ring shape with both ends open. Tubular body (1) (in Figure 3(B), integral with single-end sealed part (1a)) has inner circumferential surface (2), outer circumferential surface (3), projecting part (4), and end surface (sealing surface) (10). Plasma resistant film (9) is furnished on inner circumferential surface (2) and sealing surface (10). That is, it is an important condition that projecting part (4), which is sealed by the flat part of plasma environment sealing surface (10), which is farther toward the outer circumference than that flat part, and which is positioned at a different height from the flat part, be present.

[0029]

Figures 4(A) and (B) show aforementioned tubular body (1) attached to the device. Then, when attached to the device as shown in Figures 4(A) and (B), it is positioned on sealing surface (10) and arranged so that it is pressed by pressure application point (11) that is more toward the inner circumference than the position of contact with support member (5). High hermeticity can be further ensured by inserting elastic member (14) at the spot where projecting part (4) is positioned, and it can be securely affixed away from the plasma sealing surface on the inner circumference where film (9) is formed. Thus, the environment exposed to the plasma can be kept clean.

[0030]

The area more toward the inner circumference than the contact position of support member (5) that touches projecting part (4) during film formation can be used as the sealing surface for the plasma generation environment. By positioning the contact position of projecting part (4) for film formation and support member (5) more toward the outer circumference than pressure application point (11) that affixes sealing surface (10), a sealing surface (10) with a film formed over its entire surface will be achieved. Then by affixing sealing surface (10) after elastic member (14) for sealing is arranged more toward the outer circumference than at least the position of the contact surface with support member (5), it can be securely affixed on the plasma sealing surface toward the inner circumference on which the film is formed. Thus the environment exposed to the plasma can be kept clean.

[0031]

By forming a C surface or R surface more than 20 μm on peripheral edge part (13) where inner circumferential surface (2) and sealing surface (10), on which film (9) is formed, cross, film separation that could readily occur at peripheral edge part (13) can be prevented.

[0032]

Next, the production method of this invention will be explained in detail.

[0033]

The plasma resistant member of this invention has a silicon carbide or boron carbide film formed on the surface of tubular body (1) that is a sintered silicon carbide material or sintered boron carbide material. Because of this, excellent plasma resistance is achieved even when fluorine, chlorine, bromine, oxygen, or hydrogen alone or as a mixed gas are subjected to microwaves or high-frequency voltage at reduced pressure and turned to plasma. The fluorine gases include SF_6, CF_4, ClF_3, HF, NF_3, etc. The chlorine gases include Cl_2, BCl_3, HCL, etc. Oxygen, hydrogen, or compounds thereof may be mixed with the aforementioned gases.

[0034]

As the method for forming the film, known film formation technology, for example, CVD, may be used. In the case of silicon carbide, a CH_3 $SiCl_3$ raw material gas, and in the case of boron carbide, a raw material gas mixture of BCl_3 and C_6H_6 is introduced into the reaction vessel in which the substrate is placed. Heat is added as an energy source to produce a chemical reaction and the respective films are formed on the substrate surface. In this case, heat is added

to produce a temperature exceeding 1000 degrees, and or even as high as 1500 degrees, in order to produce a chemical reaction and control film quality and crystal orientation. It is preferable that tubular body (1) and film (9) be constituted of the same material so that a film is formed under such high temperature conditions. When different materials are used, a combination is preferable in which the coefficients of thermal expansion of both have similar values, an intermediate layer is further furnished between them to reduce residual stress in the film, and residual compression stress remains in the film.

[0035]

When film (9) with the aforementioned excellent characteristics is formed, using the abovementioned CVD, on the main surface of tubular body (1), shaped as a cylindrical dome with one end sealed or as a round ring with both ends open, that is exposed to the plasma, and on plasma generation environment sealing surface (10), by forming projecting part (4) for forming a film on a surface that is more toward the outer circumference than sealing surface (10) of tubular body (1) and that has a different height and is not exposed to the plasma, by placing support member (5), which touches projecting part (4) of tubular body (1), to make discontinuous linear contact or discontinuous point contact, and by making support member (5) out of a carbon material with a flexural strength of more than 20 Mpa, it is possible to realize a stackable manufacturing method that is excellent in terms of dismantling.

[0036]

It is possible to provide a plasma resistant member that permits excellent plasma resistance to corrosive gas plasma and has low particle [shedding] characteristics and with which an extended life can be realized by the abovementioned embodiment and method.

[0037]

An etching device to which the plasma resistant member of this invention is applied is shown in Figure 5. It has a structure in which wafer (24) is mounted on lower electrode (23) in chamber (21) and is pressed by clamp ring (22), and where high-frequency coil (25) is furnished on the outside. Among these, the abovementioned plasma resistant member of this invention can be used for chamber (21).

[0038]

Application examples

Application Example 1

What is shown in Figure 1 was produced as an application example of this invention. The diagrammatic dimensions of tubular body (1) are: maximum external diameter of the cylindrical drum with one end sealed, including projecting part (4), in Figures 1(A) and (B) is 380 mm, the external diameter of external circumferential surface (3), excluding projecting part (4), is 350 mm, the internal diameter of internal circumferential surface (2) is 320 mm, total height is 65 mm, and depth on the internal diameter side is 50 mm. The maximum external diameter of the round ring with both ends open, including projecting part (4), in Figures 1(C) and (D) is 380 mm, the external diameter of outer circumferential surface (3), excluding projecting part (4), is 350 mm, the internal diameter of inner circumferential surface (2) is 320 mm, and the total height is 50 mm.

[0039]

Tubular body (1) was produced with silicon carbide and boron carbide. For the sintered silicon carbide material, 0.6 wt% of boron carbide and 2 wt% of carbon was added to α-type silicon carbide power with a purity of 99.5% to perform CIP formation, and then it was sintered at 2060°C in a non-oxidizing environment. On the other hand, the substrate of sintered boron carbide material was sintered using a hot press. In concrete terms, a raw material in which a small amount of boron was added to boron carbide powder with a purity of 99.9% was put into a carbon mold and sintered at these conditions: sintering temperature 2200°C and molding pressure 200 kg/cm^2.

[0040]

High-purity carbon with a flexural strength of 50 MPa, 40 MPa, 30 MPa, 20 MPa, and 10 MPa was used as the material for support member (5). At the same time, items were prepared so that the contact conditions between actual support part (6) of support member (5) and projecting part (4) would give full peripheral surface contact, discontinuous surface contact, discontinuous linear contact, and discontinuous point contact.

[0041]

The external diameter of support member (5) with full surface contact is 380 mm and the internal diameter is 360 mm. The width of actual support part (6) is 10 mm, and the height for use with a cylindrical drum shape with one sealed end is 125 mm, and for use with a round ring shape with both ends open is 100 mm. Open part (8) is formed oriented along the height of

support part (5) so that gas will flow smoothly. Support member (5) for discontinuous surface contact is approximately the same shape as for full peripheral surface contact, and the width of actual support part (6) remains 10 mm, but actual support members (6), with an arc length 1/16 of the circumference, are disposed at four places equally spaced around the perimeter, and 5 mm cut-outs are placed oriented along the height in the portions without actual support parts (6). The peripheral placement of actual support part (6) of support member (5) for discontinuous linear contact is the same as for discontinuous surface contact, and R5 radius working is applied in the direction of the width of actual support part (6). With support member (5) for discontinuous point contact, hemispherically shaped projections with R5 radius are placed at positions to divide the periphery equally into four parts.

[0042]

Four stacks were made in the reaction vessel of the CVD device with the combination of flexural strengths and support member (5) contact states discussed above, it was decompressed at a temperature of 1200°C, and in the case of silicon carbide, CH_3 $SiCl_3$ raw material gas, and in the case of boron carbide, a raw material gas mixture of BCl_3 and C_6H_6 was introduced into the reaction vessel. By adding the aforementioned heat as an energy source to produce a chemical reaction, the respective films were formed to give a thickness of 400 μm on the surface of the tubular body.

[0043]

After completion of the aforementioned film formation, the vacuum vessel was opened and stacked tubular bodies (1) and support member (5) were dismantled. The results showed that, in the case where silicon carbide film was formed on a sintered silicon carbide material substrate and also in the case where boron carbide film was formed on a sintered boron carbide material substrate, regardless of the material, dismantling properties and deformation in actual support part (6), and damage to support member (5), are determined by the contact state of actual support part (6) and the material strength of support member (5). The results reflecting the contact state of actual support part (6) and the strength of support member (5) are shown together in Table 1.

[0044]

When support member (5) was used with full peripheral surface contact, projecting part (4) and support member (5) could not be easily dismantled, and a large-scale operation was required in which the side of support member (5) with projecting part (4) was cut to dismantle them. In the case of discontinuous surface contact, the cutting operation was easier than with full peripheral surface contact, but not to the extent that the large-scale cutting operation was

eliminated. By contrast, in the case of support members (5) with a discontinuous linear contact or discontinuous point contact structure, support member (5) and projecting part (4) could be separated just by applying a light impact, and the dismantling operation could be easily accomplished. However, in the case of discontinuous linear contact and discontinuous point contact, when the hardness of support member (5) was low, at 10 MPa, deformation was generated in actual support part (6) at high temperatures, dismantling characteristics deteriorated, and damage to support member (5) resulted from the impact applied during dismantling. Reworking was required to use support member (5) repeatedly.

[0045]

Thus, by having actual support part (6) of support member (5) make discontinuous linear contact or discontinuous point contact with projecting part (4), the dismantling characteristics of projecting part (4) and support member (5) after CVD film formation can be significantly improved. Deformation produced by high-temperature creep during film formation when tubular bodies (1) are stacked can be prevented by making the flexural strength of support member (5) more than 20 MPa, and satisfactory dismantling characteristics and repeated use of support member (5) will be possible.

[0046]

Table 1

1 実支持部形状	2 支持部材強度 MPa	3 解体性	4 実支持部変形	5 支持部材破損
全面接触 6	50	×	○	切断
	40	×	○	切断
	30	×	○	切断
	20	×	○	切断
	10	×	○	切断
不連続面接触 7	50	×	○	切断
	40	×	○	切断
	30	×	○	切断
	20	×	○	切断
	10	×	○	切断
不連続線接触 8	50	○	○	○
	40	○	○	○
	30	○	○	○
	20	○	○	○
	10	△	△	△
不連続点接触 9	50	○	○	○
	40	○	○	○
	30	○	○	○
	20	○	○	○
	10	△	×	×

10

Key: 1 Actual support part shape
2 Support member strength
3 Dismantling characteristics
4 Actual support part deformation
5 Support member damage
6 Full surface contact
7 Discontinuous surface contact
8 Discontinuous linear contact
9 Discontinuous point contact
10 Cutting

[0047]

Application Example 2

Five of each finished product were produced by forming a silicon carbide film 400 μm thick with CVD, using carbon support member (5) with a flexural strength of 50 MPa where projecting part (4) had discontinuous point contact, with the C surface and R surface on peripheral edge (13) of the plasma environment sealing surface of the tubular body composed of sintered silicon carbide material in the shape of a cylindrical dome with one end sealed illustrated in Application Example 1 formed to [a thickness of] 10 μm, 20 μm, 40 μm, 60 μm,

80 μm, and 100 μm. Separation of the film from peripheral edge (13) after dismantling following film formation and sealing surface polishing was confirmed. These results are shown in Table 2. Separation of the film was seen in the finished product when the C surface and R surface of peripheral edge (13) were formed to 10 μm. Because peripheral edge (13) with sintered silicon carbide material was thickened during film formation, separation due to the effects of film stress during film formation, separation caused by impact during dismantling after film formation, and processing defects that occurred when the grindstone and the worked surface, that is the surface of film (9), were separated during polishing were seen.

[0048]

Thus, when the C surface or R surface of peripheral edge (13) is formed to be more than 20 μm, film separation caused by film stress or impact or during working can be prevented.

[0049]

Table 2

基体周縁部C面 μm 1	基体周縁部の被膜剥離 発生数／母数 2	基体周縁部R面 μm 3	基体周縁部の被膜剥離 発生数／母数 2
10	2／5	10	1／6
20	0／5	20	0／5
40	0／5	40	0／5
60	0／5	60	0／5
80	0／5	80	0／5
100	0／5	100	0／5

Key: 1 C surface of substrate peripheral edge
2 Film separation at peripheral edge
No. of occurrences/modulus
3 R surface of substrate peripheral edge

[0050]

Application Example 3

Test pieces 30 mm square and 3 mm thick on which 400 μm films were formed simultaneously with Application Examples 1 and 2 were prepared, and the plasma resistance evaluated. A corrosion test was performed with Cl_2 gas plasma while cooling the test pieces by cooling the sample stage of an RIE device. For comparison, alumina ceramic used in the past was simultaneously evaluated. The ratio of the corrosion rate of silicon carbide CVD film on a

silicon carbide test piece and boron carbide CVD film on a boron carbide test piece is shown in Table 3, using the corrosion rate of alumina ceramic as reference. With the aforementioned finished products on which CVD film was formed, a low corrosion rate can be realized that is 1/40 to 1/50 that of conventional alumina ceramic.

[0051]

Table 3

	材質 (1)	腐食率 (2)
	アルミナ (3)	1
(4)	炭化珪素基体＋炭化珪素ＣＶＤ	１／５０
(5)	炭化硼素基体＋炭化硼素ＣＶＤ	１／４０

Key:
1 Material
2 Corrosion rate
3 Alumina
4 Silicon carbide substrate + silicon carbide CVD
5 Boron carbide substrate + boron carbide CVD

[0052]

With the above application examples, examples were discussed in which silicon carbide and boron carbide films were formed by CVD on substrates of sintered silicon carbide material and sintered boron carbide material by the CVD method, but the shape of the substrate for which projecting part (4) of this invention is furnished and the shape of the support part can also be applied to a member where that film is formed on a substrate constituted of an insulating material with excellent plasma resistance, e.g., silicon nitride, aluminum nitride, YAG, and $MgAl_2O_4$. In the case of silicon carbide and boron carbide, highly pure carbon can also be used for the substrate, and in this case the carbon on the substrate side must be a combination of materials with a higher strength than the carbon on the support part side. Basically, the substrate and film should be constituted of the same material, but when different materials are combined, it is also possible to use a method where a layer that has a coefficient of thermal expansion intermediate between theirs is formed between the substrate and the film to increase the adhesion between the substrate and film.

[0053]

Also, with the support member of this invention, an integrated shape was illustrated, but the important point is to improve the characteristics for dismantling it from the substrate without damaging the projecting part of the substrate. The contact surface between the support member and the substrate projecting part are constituted as a discontinuous linear contact or discontinuous point contact, and [the support member] is not limited to being an integrated type.

[0054]

Effects of the invention

As discussed in detail above, with this invention, by constructing it from a tubular body with one end sealed or both ends open, and by furnishing a plasma resistant film on the inner circumferential surface and the sealing surface of said tubular body, as well as by forming a projecting part on the outer circumferential surface, it is possible to obtain many articles with the film formation operation, and to reliably produce finished products that have little film separation.

Brief description of the figures

Figure 1 shows a plasma resistant member of this invention. (A) and (C) are plan views and (B) and (D) are cross sections.

Figures 2(A) and (B) are diagrams of the placement of each member when installed in a CVD device to form a film on the plasma resistant member of this invention.

Figure 3 shows another application example of this invention. (A) and (C) are plan views and (B) and (D) are cross sections.

Figures 4(A) and (B) are schematic views showing the plasma resistant member of this invention installed in a semiconductor manufacturing device.

Figure 5 is a schematic view of a semiconductor manufacturing device that uses the plasma resistant member of this invention.

Explanation of symbols

(1): Tubular body

(1a): Single end sealed part

(2): Inner circumferential surface

(3): Outer circumferential surface

(4): Projecting part

(5): Support member

(6): Actual support part

(7): Support stage

(8): Open part

(9): Film

(10): End surface (sealing surface)

(11): Pressure application point

(13): Peripheral edge

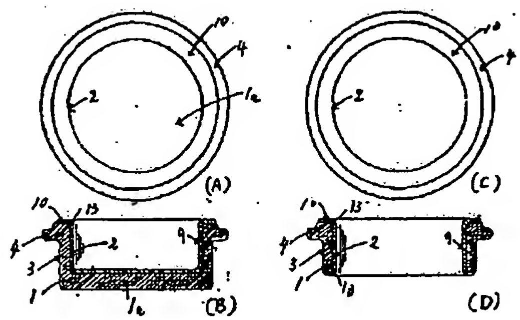


Figure 1

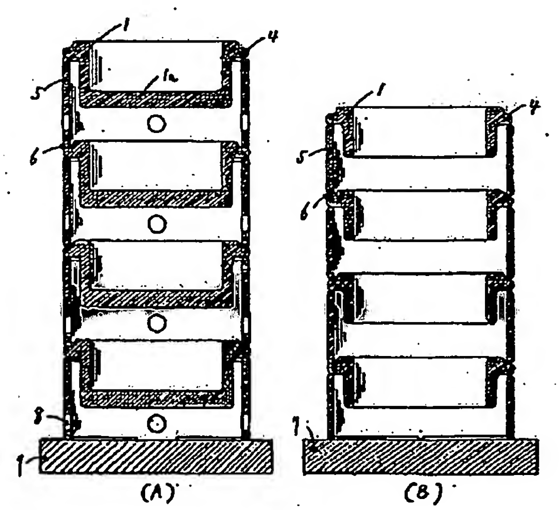


Figure 2

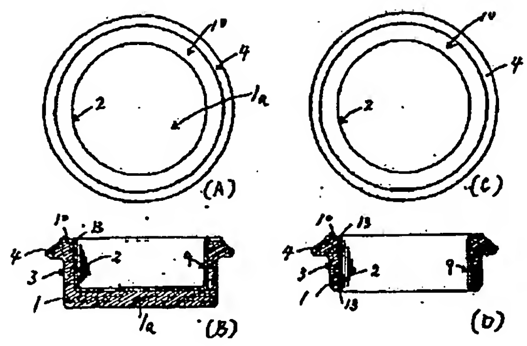


Figure 3

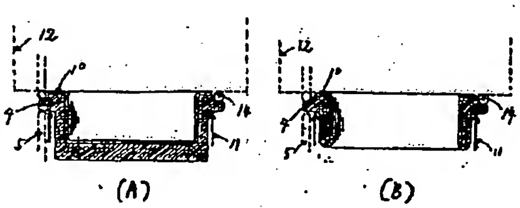


Figure 4

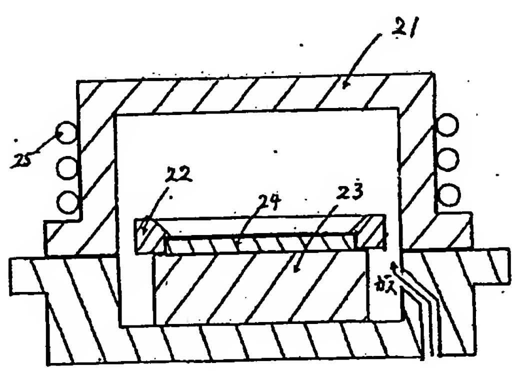


Figure 5